
LINNAEUS'S BIOLOGY WAS NOT ESSENTIALIST¹

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ABSTRACT

The current picture of the history of taxonomy incorporates A. J. Cain's claim that Linnaeus strove to apply the logical method of definition taught by medieval followers of Aristotle. Cain's argument does not stand up to critical examination. Contrary to some published statements, there is no evidence that Linnaeus ever studied logic. His use of the words "genus" and "species" ruined the meaning they had in logic, and "essential" meant to him merely "taxonomically useful." The essentialism story, a narrative that has most pre-Darwinian biologists steeped in the world view of Plato and Aristotle, is ill-founded and improbable.

Key words: A. J. Cain, essentialism, history of systematics, history of taxonomy, Linnaeus, E. Mayr.

The Missouri Botanical Garden has celebrated the 250th anniversary of the publication of Linnaeus's *Species Plantarum* (Linnaeus, 1753), but there are doubtless some biologists who are not sure if they are proud of that landmark. After all, we have now departed so far from the beliefs of that eccentric old Swede that it is rather embarrassing to count him among our intellectual ancestors. Didn't he think that every species was directly created by God, in other words, wasn't he a creationist and thus an enemy of evolution? More profoundly, didn't Linnaeus believe that every species has its own essence, that is, type in the Platonic sense? Well, to be blunt, no, and no. His views on the fixity of species changed in his lifetime, and the business about essentialism is the scholarly equivalent of an urban myth, that is, a story everyone repeats but for which there is scant basis in fact.

That the mature Linnaeus abandoned his youthful insistence on the fixity of species was pointed out by Edward Greene (1909) and fully documented by John Ramsbottom (1938). Linnaeus was perfectly comfortable imagining that God may have made, in His original burst of creativity, only one species per genus, while natural processes later caused the emergence of the others. Although it is very well known that Linnaeus underwent this shift from absolute fixity to limited transmutation (Larson, 1971; Koerner, 1999; Müller-Wille, 1999), I remind you of it because it so clearly contradicts the urban myth about essentialism. The whole point about Platonic types, we have been told time and again, is that there are unbridgeable gaps separating them. Did

the mature Linnaeus think that some species were created with an immutable essence and others with mutable essences? Ernst Mayr deserves credit for admitting the problem (1982: 259), but he leaves us to conclude that Linnaeus was hopelessly confused and inconsistent. I suggest that it is we who are confused, for we attribute to Linnaeus a philosophical notion he never held.

Actually, I suspect that many of us are allowing the spectre of modern creationism to bias our understanding of a pre-Darwinian creationist like Linnaeus. To a modern biologist who does not believe in God, Linnaeus's explicit piety has the effect of making the essentialism story seem plausible, but the link connecting these realms was the insight of a later generation. In 1857 Louis Agassiz, disturbed by the rising interest in evolution, argued in his "Essay on Classification" that the Creator had conceived each species in his divine intellect before giving it material existence (Winsor, 1991). He repeated these ideas after Darwin's revolutionary book appeared in 1859, and Agassiz remained adamant that the patterns recorded by taxonomists were direct evidence of God's thoughts. But all this was a century after Linnaeus. In Linnaeus's day the "requirements of Christian faith," contrary to Mayr's claim (1982: 259), did not forbid the possibility that the "kinds" mentioned in the Book of Genesis could have been at the taxonomists' rank of genus rather than species. Those modern biologists who do believe in God will have more sympathy with Linnaeus than with Agassiz, because they accept that the Creator willed into existence our actual world,

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including life with all its evolutionary complexity and history. Those biologists realize that belief in God does not logically entail belief in the fixity of species.

The mature Linnaeus's limited transmutation was, Mayr (1982: 259) admits, "not only inconsistent with everything he had said and believed before but was in fact irreconcilable with essentialism." It is time, then, to look more carefully at this supposed doctrine or dogma of essentialism. Without a doubt, there does exist today a story about essentialist beliefs in past centuries. It is this story, that is, this historical claim about the world-view of past taxonomists, that I am challenging. (Some philosophers are now refurbishing the word essentialism for variously modernized concepts of natural kinds, but the biological and historical literature to which I refer was innocent of such sophistication. Whether concepts of natural kinds corresponding to such 21st century usage were held in the past is an entirely separate question not relevant here [Boyd, 1999: 152; Ellis, 2002].) I begin by laying before you only one telling of the essentialism story, but it stands for other repetitions that number in the thousands, if we include undergraduate lectures. The latest edition of one of the most widely used textbooks, *Evolutionary Biology* by Futuyma (1998: 448), puts it this way:

Linnaeus and other early taxonomists held what Ernst Mayr (1942, 1963)³ has called a "TYPOLOGICAL" or "ESSENTIALIST" NOTION OF SPECIES. Individuals were members of a given species if they sufficiently conformed to that "type," or ideal, in certain characters that were "essential" fixed properties—a concept descended from Plato's "ideas" (see chapter 1).

Here are the relevant passages in his chapter 1 (Futuyma 1998: 6):

In positing an evolutionary process wherein natural selection sorts among hereditary variations, *Darwin identified variation as a centrally important fact of biological systems*. In doing so, he broke with a 2000-year-old tradition that had dominated Western thought. The tradition stemmed from Plato, whose philosophy was built on the concept of the "eidos," the "form" or "idea," a transcendent ideal form imperfectly imitated by its earthly representations. In his famous metaphor of the cave in *The Republic*, Plato likened earthly objects, such as the triangles or horses we are familiar with, to the shadows cast on the wall of a cave by objects that pass by the entrance. Like people within the cave, bound so that they face the wall, we see only the shadows, the imperfect representations, of reality. Likewise, the reality—the ESSENCE—of the true equilateral triangle is only imperfectly captured by the triangles we draw or construct, all of which are imperfect, and vary from the true, essential

triangle. And so it is with horses, or any other species: each has an eternal, immutable essence, but each individual has imperfections. In this philosophy of ESSENTIALISM, variation is accidental imperfection; only essences matter.

Plato's philosophy of essentialism became incorporated into Western philosophy. Its central tenet was that however much the objects in a class might accidentally vary, the class still had a defining essence that could not change. Thus each species—horse, zebra, or ass, for instance—has an essence, and one cannot be changed into another any more than a triangle can vary enough to become a rectangle.

The chief source of this historical narrative is Ernst Mayr (1959, 1963, 1968, 1976, 1982), whose words have carried such authority that his claims have been rarely questioned. Yet in its broad sweep across the history of systematics, this story is not merely inaccurate in particulars, it is wrong and harmful in its basic message. According to the essentialism story, Platonic idealism dominated Western thought until Darwin broke its spell, whereas in fact, William of Ockham in the 14th century and other nominalists dealt it crushing blows from which it never recovered. Systematic biology evolved, largely independent of philosophy, from the 16th century onward, through the actions of an army of herbalists, encyclopedists, makers and cataloguers of collections, and other naturalists, whose joint efforts built up the mountain of data that Linnaeus confronted. None of Linnaeus's numerous enemies noticed any remnant of Plato's ideal forms in the series of catalogues the Swedish professor and his followers kept churning out. Quite the contrary, one philosopher later noted with surprise and respect that naturalists' success in their massive project of inventory seemed to involve an active neglect of the classic rules of logical definition (Whewell, 1847; Winsor, 2003). By suppressing this rich history, the essentialism story distorts the historical and logical foundation of Darwinism.

To fully understand the creation and impact of the essentialism story would require us to take it apart and examine it piece by piece, but at present I will limit my attention to the claim that Linnaeus himself was in thrall to this philosophy. Mayr's sources for this claim are impressive, including such scholars as James Larson (1971) and Frans Stafleu (1971). Yet a close examination of all Mayr's sources reveals that instead of a literature of accumulating evidence, all derive from a single source, an article by Arthur J. Cain in the *Proceedings of the Linnean Society of London* (1958). There the Oxford zoologist maintained that Linnaeus thought in terms of Aristotelian essences; the backbone of his claim is that "the method [Linnaeus] adopted was to classify by the rules of Logical Division, which involve the determination

³ Mayr does set out the essentialism story on pp. 4–6 and 16–17 of his 1963 book (using only the term "typological"), but not in his 1942 book.

of the essence of each entity” (Cain, 1958: 162). Cain’s conclusions are now woven into the fabric of established knowledge, repeated countless times by people who have never read him. Scholars who subsequently contributed fresh research on Linnaeus, ironically including Cain himself (Broberg, 1985; Stevens & Cullen, 1990; Cain, 1992, 1993, 1994, 1995; Müller-Wille, 1999) are perceived, if they are read at all, as supplementing Cain’s 1958 conclusions, even though they paint a very different picture.

A few years ago I undertook a careful examination of Cain’s 1958 article as part of a project concerned with why some scientists turn their attention to questions about the past (Winsor, 2001). My intention was to investigate the phenomenon of scientists turning to history, and both Cain and Mayr were in the prime of their scientific careers when they began to write about history in the 1950s. My interest was Cain’s motivation, not Linnaeus’s reputation, but I found myself amazed by the many weaknesses in Cain’s argument. It would seem that Cain’s conclusions took hold because they meshed so well with two other semi-independent and simultaneous lines of thought. One was Mayr’s association of the morphological concept of species with typology, which included tracing typology back to Plato’s cave (Mayr et al., 1953: 15; Mayr, 1976: 256–257). Another strand flowed from David Hull’s 1965 article “The effect of essentialism on taxonomy—two thousand years of stasis.” The essentialism story known today consists of elements from each strand, which were twisted tightly together in 1968 when Mayr decided that the concept of species he called “typological thinking” could be equated with the concept of essentialism he found in Hull. I intend to trace out elsewhere the distinct history of those three strands.

Cain believed he had made a breakthrough in understanding Linnaeus when he learned that Aristotelian logic mandated that definition should proceed by stating the kind (*genus* in Latin) to which a species belongs (man is an animal) and then stating the *differentia*, the features that distinguish it from the other members of that kind (man is a rational animal). Linnaeus’s rule that every species name must begin with the name of the genus to which it belongs was what had first made Cain suspicious, and then the telltale words *definitio*, *differentia*, and *essentialis* seemed to confirm it. Indeed the case seemed beyond doubt when Cain found a series of incriminating pronouncements in Linnaeus’s *Philosophia Botanica*, which he rendered as “The *Essential Character* of a genus is that which gives some characteristic peculiar to it, if there is one such, which will instantly serve to distinguish it from all others in the same natural order [*Phil. Bot.*, 187] The true specific

name is a *Differentia essentialis* (*Phil. Bot.*, 257) distinguishing that species from all others in the same genus.... The *Character essentialis* [of a species] is a *Differentia* (*Phil. Bot.*, 258)” (Cain 1958: 148). These words of Linnaeus equipped Cain to argue that however messy and complicated his system became in practice, fundamentally Linnaeus must have been engaged in this sterile scholastic game.

The game was indeed scholastic, for the procedure of formulating definitions *per genus et differentiam* was an exercise familiar to generations of scholars in medieval universities, based upon the 6th century scholar Boethius’s commentaries on and Latin translation of the 3rd century Greek scholar Porphyry’s introduction to Aristotle (Kretzmann et al., 1982; Spade, 1994). Porphyry’s notorious “five words” are rendered by Boethius *genus*, *species*, *differentia*, *propria*, and *accidens*. What Cain did not realize was the extent to which teachers in Linnaeus’s day, and indeed many of the medieval schoolmen, regarded the whole business as a taxonomy of words, not things (Arnauld & Nicole, 1662). (What Aristotle himself would have thought of it [Balme, 1980, 1987: 73; Gotthelf, 1985] is quite another matter.) If the task is to define the word “horse,” a schoolboy learned not to mention the features peculiar to his own mare Rosalind, such as her location and color, and not to compose a tedious list of all those features, such as being four-legged and having a mane and tail, that she shares with asses and zebras; the frugal and proper approach is simply to state the group name (“equine”) plus the features distinguishing horses from others of this group. It was widely understood that this elementary exercise arouses the thorny question of whether the abstract “horse” (the universal), the idea or type of horsiness to which Rosalind somehow belongs, really enjoys existence in some eternal place, as Plato said, or has a more limited existence as the active power within each individual horse, as Aristotle said, or exists only nominally, as a product of our own mind, as William of Ockham said. Philosophers debated the question, but the relevant point here is that their debate did not touch the rules of proper definition. Even for a nominalist, it is efficient to describe an object that resembles other objects by first stating the set of similar things, and then pointing to the features by which this one differs.

The supposedly essentialist views Cain quoted from Linnaeus could have been multiplied, for Linnaeus also declared “The concept of a species consists of an essential feature, by which alone it is distinguished from all others in the same genus.... A specific definition contains features in which the species differs from those in the same genus. But the specific name contains the essential features of the defini-

tion.... Therefore the specific name is the essential definition" (Linnaeus, 1751: 219–220). (Note that for Linnaeus, the "name" of the species was not its two-word shorthand form, but the genus name modified by up to a dozen adjectives.) However, it would be a sin against a prime principle of historiography (understanding actions and words in the context of their own time) if we were to assume that Linnaeus was using the word *essentialis* in the same sense as medieval philosophers had. The context, as well as his own definition, shows that the word only meant "taxonomically useful" and nothing more. What he called the "character" of a genus was the list or suite of features found to be dependable, and these he categorized with three adjectives: *factitius*, *essentialis*, and *naturales*. The first was a single feature used in some botanist's artificial system; the second was a single feature, or as few as possible, peculiar enough that it serves to distinguish this genus from the other genera in its natural order. The third was the full list of features. The *character essentialis* was desirable because it enabled the production of a succinct catalog. Nowhere did Linnaeus suggest that the "essential" features were any closer to the inner nature of a plant than its other features. On the contrary, he insisted that botanists pursue the *characteres naturales*. Linnaeus (1751: 143) wrote,

If the essential characters of all genera had been discovered, the recognition of plants would turn out to be very easy, and many would undervalue the natural characters, to their own loss. But they must understand that, without regard for the natural character, no one will turn out to be a sound botanist; for when new genera are discovered, the botanist will always be in doubt if [he] neglects the natural character. Anyone who thinks that he understands botany from the essential character and disregards the natural one is therefore deceiving and deceived; for the essential character cannot fail to be deceptive in quite a number of cases. The natural character is the foundation of the genera of plants, and no one has ever made a proper judgement about a genus without its help; and so it is and always will be the absolute foundation of the understanding of plants.

In erecting these terms, Linnaeus may have had in mind the famous exchange between John Ray and Joseph Pitton de Tournefort (Sloan, 1972; McMahon, 2003), but if so, he was siding with Ray and thumbing his nose at Tournefort, by choosing to define *essentialis* solely by its taxonomic convenience rather than by reference to a plant's essential nature.

The telltale words that had first caught Cain's attention, "genus" and "species," actually testify most damagingly against his claim that Linnaeus was following the rules of logical division. As every medieval schoolboy knew, Boethius's *genus* and *species* were relative terms. One may correctly say

that "bird" is a *genus* containing the *species* "swan," but it is equally true that "bird" is a *species* in the *genus* "animal." A person devoted to scholastic principles, who decided to set up a system running from Kingdoms containing Classes to Classes containing Orders, would be obliged to avoid the logical terms *genus* and *species* for the next two ranks, for each Class is a *species* with respect to its Kingdom, but a *genus* with respect to its Orders. The fact that Linnaeus appropriated these old words and spoiled them by attaching them to absolute ranks in his hierarchy proves his utter disregard for the "Aristotelian" rules of logic.

I am myself no expert on Linnaeus, so I was relieved to find that the skepticism to which I was led by a close reading of Cain had already been independently adopted by Staffan Müller-Wille (1999) through his close reading of Linnaeus. His work, which is not yet as well known as it deserves to be, makes me confident that the tide of opinion on this issue must turn. Yet the process will not be easy, for the essentialism story can bias our reading without our noticing. Consider one significant detail from Mayr's *Growth of Biological Thought* (1982: 173): "In school Linnaeus had excelled in logic, and he was evidently deeply impressed by the precision of this method." Here we have an instance of history by deduction, for Cain's argument certainly does require us to imagine that Linnaeus had mastered scholastic logic. Yet Cain had no evidence to that effect, so he could only beguile his readers by saying that "every well-educated man in and before Linnaeus's time might have been given some instruction in the principles of classification in general, as laid down by Aristotle. This he would receive in the study of *Logic*..." (Cain, 1958: 145). Notice the ambiguity of the pronoun "he," which could easily be misread as "Linnaeus" though it properly refers only to some "well-educated man." Leaving aside the quibble that Linnaeus was not particularly well-educated by 18th century standards, Cain's claim is true only because of his carefully qualified verb "might have been given." An educated man might have studied Aristotelian logic, but then again, he might not.

Actually there is no evidence that Linnaeus studied logic at all, much less excelled at it, according to Müller-Wille (pers. comm.). Indeed the positive assertion of excellence in school is peculiarly at odds with the slight evidence we do have. Among Mayr's sources, the one that reports on Linnaeus's schooling, Blunt (1971: 18), says this:

In 1724 he passed, though with no great distinction, into the Gymnasium. Here the curriculum was designed to fit the needs of boys intended for the priesthood; the emphasis was upon Greek, Hebrew, theology, meta-

physics and oratory—subjects in which he was little gifted and even less interested. Apparently he shone at physics and mathematics....

This is an accurate summary of Linnaeus's own autobiography, which claims excellence in science and makes no mention of logic (Fries, 1923). The erroneous tidbit about his not only studying logic but being deeply impressed by it may now be hard to erase, however, because of being stated so clearly in Mayr's authoritative book.

The essentialism story that engulfed and incorporated Cain's 1958 argument also transformed it. Absent from Cain's article is the very word "essentialism," which had been used by Karl Popper (1944: 94) to expose a fallacious and dangerous habit of thought. The fallacy is one into which reasonable people are prone to fall, namely, to believe that we can find out the true nature of something by concocting a definition of the word that names it. (Actually Popper assumed that no 20th century scientist really believed this, so he aimed his criticism at "methodological essentialism," which means acting as though one believes it.) Popper's 1945 book *The Open Society and Its Enemies* further developed the concept, but there is no evidence that either Cain or Mayr took notice. David Hull's 1965 paper, which featured Popper's word and concept, was almost certainly how Mayr learned of them; Hull mailed him a copy of his paper, which was the start of Mayr's mentorship of Hull. (Mayr very graciously allowed me to examine their correspondence along with his other papers in the Harvard University Archives.) Hull recognized that there were some problems with Cain's argument (Hull, 1965: 316n, 1967, 1985), but he did not quarrel with Cain's basic message, that Linnaeus was in the business of defining species like a logician rather than describing them like a natural historian. The connection between Popper's concept and what bothered Mayr—"typological thinking" about species—was somewhat loose (Mayr considered Plato rather than Aristotle the enemy), but in general, Cain's assessment of Linnaeus seemed to fit into both Hull's and Mayr's views of the history of taxonomy.

When we consider how deeply Linnaeus was steeped in the literature and traditions of early modern botany and zoology, is it even likely that he would have fallen into the fallacy of essentialism? We need to realize that Popper was by no means the first thinker to warn people against it. The rhetoric of the Scientific Revolution, including the writings of Bacon, Descartes, and Locke, was consistently anti-scholastic. It was clear to every student of Linnaeus that the business of the true botanist was to interrogate nature; after all, he had emphasized that his own classes and

orders were artificial devices, invented to ease identification.

What about Mayr's concern that individual differences, so crucial for Darwinian evolution, would have been discounted as mere accidents by any follower of classic logic? Cain later showed (1996) that the logicians' concept of "accident" had considerably faded by John Ray's time, but Mayr was surely correct that taxonomists wanted to find constant characters and did their best to weed out variable characters. This was obviously a practical issue, but whether the concepts of scholastic logic played any role at all in 18th century taxonomy, or even in the two previous centuries, entirely remains to be demonstrated.

Unfortunately, the essentialism story has tended to dampen interest in the rich and complex story of exactly how taxonomists, both before and after Darwin, coped with the real-world challenges of comparing and identifying organisms. To loosen its grip, we could begin by recognizing that maligning Linnaeus distorts our understanding of the entire history of systematics.

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